CLAIMS

1. An information storage apparatus comprising:

cold cathode electron beam emitting means; and

a storage medium for storing and reading information in accordance with irradiation with an electron beam emitted from the cold cathode electron beam emitting means.

2. The information storage apparatus of claim 1, wherein cold cathode electron beam emitting means includes a cold cathode having a sharp point.

3. The information storage apparatus of claim 1, wherein the cold cathode electron beam emitting means includes a cold cathode having a carbon nanotube.

4. The information storage apparatus of claim 3, wherein the cold cathode electron beam emitting means includes a cold cathode having a base and a carbon nanotube placed on the base and projecting from the base.

5. The information storage apparatus of claim 3, wherein the cold cathode electron beam emitting means includes a cold cathode having a base and a plurality of carbon nanotubes placed on the base.

6. The information storage apparatus of claim 5, wherein in the cold cathode, the carbon nanotubes project from the base in substantially the same direction and have substantially the same length.

7. The information storage apparatus of claim 1, wherein the cold cathode electron beam emitting means is configured by using a ballistic electron emitting element.

8. The information storage apparatus of claim 1, wherein the cold cathode electron beam emitting means includes a cold cathode placed in a chamber surrounded by a partition and a film capable of transmitting an electron beam, and

the inside of the chamber has a vacuum degree higher than the outside thereof.

9. The information storage apparatus of claim 8, wherein an electron beam is accelerated by application of a given voltage to the film capable of transmitting an electron beam.

10. The information storage apparatus of claim 1, further comprising accelerating means for accelerating an electron beam emitted from the cold cathode electron beam emitting means by using an electric field.

11. The information storage apparatus of claim 10, wherein the accelerating means includes an annular electrode having an aperture.

12. The information storage apparatus of claim 11, wherein the annular electrode is divided along radius directions such that at least one pair of opposed electrodes are formed, and

the annular electrode also serves as deflection means for deflecting an electron beam emitted from the cold cathode electron beam emitting means.

13. The information storage apparatus of claim 10, wherein the accelerating means includes a plurality of electrodes to which voltages with different phases are respectively applied, and

the accelerating means is configured to accelerate the electron beam by generating a moving electric field.

14. The information storage apparatus of claim 1, further comprising:

convergence means for causing an electron beam emitted from the cold cathode electron beam emitting means to converge by using an electric field or a magnetic field; and

deflection means for deflecting the electron beam by using an electric field or a magnetic field,

wherein a plurality of regions of the storage medium is allowed to be selectively irradiated with the electron beam.

15. The information storage apparatus of claim 14, wherein the deflection means includes at least one pair of opposed electrodes.

16. The information storage apparatus of claim 14, wherein the convergence means includes an annular electrode having an aperture.

17. The information storage apparatus of claim 16, wherein the annular electrode is divided along radius directions such that at least one pair of opposed electrodes are formed, and

the annular electrode also serves as the deflection means.

18. The information storage apparatus of claim 1, wherein the cold cathode electron beam emitting means includes a plurality of electron-beam emitting parts, and

the electron-beam emitting parts emit respective electron beams at different timings in accordance with a distance from a given center so as to converge the emitted electron beams.

19. The information storage apparatus of claim 1, further comprising:

shielding means for partly transmitting an electron beam emitted from the cold cathode electron beam emitting means; and

actuator means for moving at least one of the shielding means and the storage medium along the surface of the other,

wherein a plurality of regions of the storage medium are allowed to be selectively irradiated with the electron beam.

20. The information storage apparatus of claim 19, wherein the shielding means includes a plate member having a minute hole.

21. The information storage apparatus of claim 20, wherein the shielding means is configured to generate an electric field for causing the electron beam to converge and pass through the minute hole.

22. The information storage apparatus of claim 21, wherein the shielding means is configured to generate an electric field for causing the electron beam to converge and pass through the minute hole by application of a voltage to one of the plate member having

conductivity and a conductive member provided on the plate member.

23. The information storage apparatus of claim 1, wherein the storage medium is configured to store information in accordance with a phase change between a crystallized state or an amorphous state by irradiation with electron beams of at least two types having different energy levels,

read means is further provided, and

upon irradiation of the storage medium with an electron beam at an energy level lower than that during storage of information, the read means reads stored information by distinguishing between the crystallized state and the amorphous state depending on at least one of a voltage between the front and back of a region irradiated with the electron beam and current flowing between the front and back of the region.

24. The information storage apparatus of claim 1, wherein the storage medium is configured to store information by forming a hole or changing a film thickness upon irradiation with an electron beam at a first energy level, and

read means for reading stored information by detecting current flowing via the storage medium upon irradiation of the storage medium with an electron beam at a second energy level lower than the first energy level is further provided.

25. The information storage apparatus of claim 24, wherein the storage medium is made by using a material having a high resistivity to detour current flowing in a region of the storage medium where no hole is formed upon irradiation with the electron beam to a face of the storage medium irradiated with the electron beam.

26. The information storage apparatus of claim 1, wherein the storage medium has an insulator film and is configured to store information by accumulation of charge in the insulator film upon irradiation with the electron beam, and

read means for reading stored information by detecting current flowing depending on the presence and absence of the accumulated charge upon irradiation with the electron beam is further provided.

27. The information storage apparatus of claim 1, wherein the storage medium is configured to obtain a fluorescent property by irradiation with an electron beam at a first energy level, and

an optical detector for detecting fluorescence emitted from the storage medium upon irradiation of the storage medium with an electron beam at a second energy level lower than the first energy level is further provided.

28. The information storage apparatus of claim 1, wherein a voltage applied to the cold cathode electron beam emitting means, a pulse duty ratio, the number of pulses, an accelerating voltage for the electron beam or the degree of convergence of the electron beam is controlled so as to control the energy of the electron beam.

29. The information storage apparatus of claim 1, further comprising a plurality of cold cathode electron beam emitting means so that a plurality of bits of information is stored and read out at the same time in/from a plurality of regions of the storage medium.

30. The information storage apparatus of claim 14, further comprising a plurality of cold cathode electron beam emitting means,

wherein the deflection means is configured to deflect electron beams emitted from the plurality of cold cathode electron beam emitting means in accordance with a common control signal so that a plurality of bits of information is stored and read out at the same time in/from a plurality of regions of the storage medium.

31. The information storage apparatus of claim 19, further comprising a plurality of cold cathode electron beam emitting means,

wherein the shielding means is configured to partly transmit each of electron beams emitted from the plurality of cold cathode electron beam emitting means,

the actuator means is configured to move one of the shielding means and the storage medium in accordance with a control signal for each moving direction, and

a plurality of bits of information is stored or read out at the same time in/from a plurality of regions of the storage medium.

32. The information storage apparatus of claim 31, wherein the shielding means includes a plate member having a plurality of minute holes associated with the respective electron beams.

33. The information storage apparatus of claim 30, further comprising irradiated-position-shift detecting means for detecting a shift between a given reference position and a position in the storage medium irradiated with each of the electron beams in accordance with deflection of said each of the electron beams by the deflection means,

wherein the position irradiated with the electron beam is controlled by the deflection means in accordance with a result of the detection by the irradiated-position-shift detecting means.

34. The information storage apparatus of claim 31, further comprising irradiated-position-shift detecting means for detecting a shift between a given reference position and a position in the storage medium irradiated with each of the electron beams in accordance with the movement of said one of the shielding means and the storage medium by the actuator means,

wherein the position irradiated with each of the electron beams is controlled by the actuator means in accordance with a result of the detection by the irradiated-position-shift detecting means.

35. The information storage apparatus of claim 33, wherein the irradiated-position-shift detecting means detects a shift between a given reference position and a position in the storage medium irradiated with at least one electron beam emitted from at least one of the plurality of cold cathode electron beam emitting means, and

the position irradiated with the electron beam is controlled by the deflection means with respect to one or more electron beams emitted from the other cold cathode electron beam emitting means in accordance with a result of the detection by the irradiated-position-shift detecting means.

36. The information storage apparatus of claim 34, wherein the irradiated-position-shift detecting means is configured to detect a shift between a given reference position and a position in the storage medium irradiated with at least one electron beam emitted from at least one of the plurality of cold cathode electron beam emitting means, and

the position irradiated with the electron beam is controlled by the actuator means with respect to one or more electron beams emitted from the other cold cathode electron

beam emitting means in accordance with a result of the detection by the irradiated-position-shift detecting means.

37. The information storage apparatus of claim 30, wherein an electron beam emitted from a part of the plurality of cold cathode electron beam emitting means is used to store and read at least one of error detecting code or error correcting code in storing or reading of information by using one or more electron beams emitted from the other cold cathode electron beam emitting means.

38. The information storage apparatus of claim 31, wherein an electron beam emitted from a part of the plurality of cold cathode electron beam emitting means is used to store or read at least one of error detecting code and error correcting code in storing or reading of information by using an electron beam/electron beams emitted from the other cold cathode electron beam emitting means.